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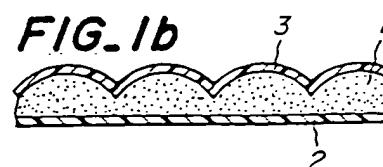
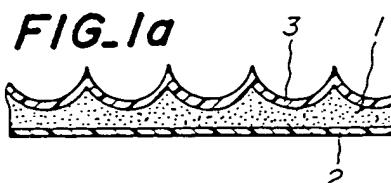
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㉓ Irregular section adhesive sheets.

㉔ An adhesive sheet having an irregular section adhesion face comprising a substrate (2) and a pressure-sensitive adhesive layer (1) applied thereto and having an uneven adhesion face.



IRREGULAR SECTION ADHESIVE SHEETS

This invention relates to an adhesive sheet having an adhesion face of irregular section, and more particularly to adhesive sheets which are very easy to peel and re-use and have irregular section at the adhesion face.

In general, it is well-known that a pressure-sensitive adhesive is frequently used when a first sheet material is laminated to a second sheet material. However, if it is required to peel the first sheet adhered with the pressure-sensitive adhesive from the resulting laminate sheet and laminate it to another sheet material, there is a problem that the peeling of the first sheet cannot be performed because of a strong adhesion force or, if peeling is possible, the second sheet may be broken.

Therefore, it is usual to use a pressure-sensitive adhesive having a low adhesion force or a so-called easy-releasable pressure-sensitive adhesive for performing the relamination as mentioned above. However, such a pressure-sensitive adhesive has drawbacks that repeated laminating is impossible and turning or peeling tends to be caused from the end of the laminated sheet in use. That is, this adhesive is lacking in reliability.

When the area of the sheet material becomes wider than a certain value, it is very difficult to perform the laminating itself. For example, when a wall paper is laminated onto a wall, wrinkles or air pockets are apt to be produced, so that the application of the wall paper becomes difficult for less experienced persons. That is, a highly skilled technique is required in laminating of wall paper or the like.

It is, therefore, an aim of the present invention to overcome or at least mitigate the aforementioned drawbacks of the conventional techniques and provide an adhesive sheet with a high reliability which can be readily re-laminated even by an inexperienced person and which does not peel in use.

According to the invention, there is provided an irregular section adhesive sheet comprising a substrate and a pressure-sensitive adhesive layer adhered to said substrate and having an uneven adhesion face.

The term "irregular section" used herein means that when the adhesive sheet is vertically cut at an optional position, the cut surface in section of the pressure-sensitive adhesive layer is uneven or air passages are formed in the adhesion face. Furthermore, the term "air passage" used herein means a passage for rapidly discharging air from the laminated sheet without retaining therein.

The pressure-sensitive adhesive preferably has a crosslinking structure. More particularly, the pressure-sensitive adhesive may be a rubber series adhesive, and particularly suitable is a butyl rubber series adhesive composed mainly of halogenated butyl rubber and/or ethylene-propylene-diene terpolymer rubber, polybutene, photopolymerizable compound, silica and photosensitizer and crosslinked through irradiation of ultraviolet rays. Alternatively, the pressure-sensitive adhesive may be an acrylic series adhesive.

The adhesion face of the pressure-sensitive adhesive layer may be suitably provided with air passages, which may be formed by arranging the pressure-sensitive adhesive in the form of islands or in the form of stripes.

The invention will be further described, by way of example only, with reference to the accompanying drawings, wherein:

Figs. 1a and 1b are partial section views of embodiments of irregular section adhesive sheet according to the invention, respectively; and

Figs. 2 and 3 are perspective views of other embodiments of irregular section adhesive sheet according to the invention; respectively.

As mentioned above, the irregular section adhesive sheet according to the invention comprises a substrate and a pressure-sensitive adhesive layer adhered thereto and having an uneven adhesion face. Therefore, the boundary face between the adhesive sheet and an adherend approaches point-contact or line-contact, so that the adhesive sheet comes into partial contact with the adherend at any position.

In general, when an area-contacted adhesive sheet is peeled from the adherend, if a pressure-sensitive adhesive having a high adhesion strength is used as the pressure-sensitive adhesive layer, the adhesive sheet cannot be peeled in a reusable state because failure occurs in the inside of the adhesive layer or the substrate, or a part of the adhesive remains on the adherend to spoil the appearance and damage the reuse of the adhesive sheet itself.

In the adhesive sheet according to the invention, since the contact type is a partial contact at the irregular sectional, even when using a pressure-sensitive adhesive with a high adhesion strength, the adherend portion and the non-contact portion alternately occur at the peeling face in the peeling from the adherend, so that the peeling can easily be made because the peeling point shifts from the adhered portion to the non-contact portion before material failure occurs in the adhered portion.

That is, no material failure is caused by repeating this shifting phenomenon, so that the peeling can be

smoothly performed over the whole of the sheet.

Furthermore, since a pressure-sensitive adhesive having a high adhesion strength is used as the adhesive layer, there is naturally caused no peeling from the end of the sheet in use and the reliability is very high. Moreover, the adhesive sheet according to the invention can be repeatedly used to be applied to various adherends many times.

In another embodiment of an adhesive sheet according to the invention, the pressure-sensitive adhesive is extended onto the substrate in the form of islands or stripes to render the adhesion face in an uneven state, whereby air passages are formed between the islands or the stripes. When the adhesive sheet is laminated to a support, air escapes through the air passages to form no air pockets between the adhesive sheet and the support, so that the lamination is very easy.

According to the invention, it is necessary to maintain the irregular section of the adhesion face or the island or stripes form of the pressure-sensitive adhesive layer over a long period of time, considering that the irregular section of the adhesion face changes due to the fluidity of the pressure-sensitive adhesive in use or storage. For this purpose, it is preferable to introduce a crosslinking structure into the pressure-sensitive adhesive.

As mentioned above, the adhesive sheet according to the invention can freely peel even for a long time after the lamination and also be subjected to repetitive use and peeling many times. Furthermore, the adhesive sheet according to the invention can be applied to any kind of material as an adherend, so that it may be usable over a wide range of applications inclusive of a relatively large surface area, such as advertising media, various markings, interior and exterior decorations for buildings, and transportation means, electric appliances, indoor and outdoor fixtures, public working articles, ocean articles, living articles, toys, sports requisites, playthings and the like,

In the adhesive sheet according to the invention may be used various pressure-sensitive adhesives such as rubber series adhesives, acrylic adhesives, urethane series adhesives, silicone series adhesives, 25 epoxy series adhesives and so on. After the adhesion face of such a pressure-sensitive adhesive layer is made uneven to form an irregular section of the adhesion face, the cross-linking structure may be introduced into the adhesive layer, if necessary.

The introduction of the crosslinking structure is carried out by heat or through irradiation by electromagnetic waves, particularly electron beams or ultraviolet rays.

30 As the pressure-sensitive adhesive to be used in the adhesive sheet according to the invention, rubber series adhesives capable of easily forming an irregular section profile and being easily crosslinked through ultraviolet rays, particularly butyl rubber adhesives, are preferable.

As such a photo-crosslinkable butyl rubber adhesive, there is, for example, an adhesive having the following composition.

35	brominated butyl rubber	40 (part of weight)
	polybutene 2000H	60
	silica	12
	trimethylol propane triacrylate	3
40	benzoinisopropyl ether	0.4
	2,6-dimethyl-p-cresol	0.4

In addition all crosslinked adhesives are naturally usable as mentioned above.

45 The formation of an irregular section profile of uneven adhesion face may be carried out by various methods, for example a method wherein the adhesive sheet is pressed in a previously engraved press mold, a method wherein the sheet is passed between engraved rolls, or a method wherein the sheet is pressed in a mold or passed between rolls together with a releasing paper or film having an irregular section profile;

50 On the other hand in order to apply the pressure-sensitive adhesive layer in the form of islands, there may be used various print and dyeing techniques such as a textile printing process, silk screening process, flat bed printing process, gravure printing process and modified processes thereof. In the case of forming the adhesive layer into a stripes form, the above printing techniques can be used, but extrusion coating or a comb-type doctor blade process can be conveniently applied in the case of the formation of parallel stripes.

The invention will be further described with reference to the following illustrative Examples.

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#### Example 1

## (A) Preparation of pressure-sensitive adhesive

A composition having the following compounding recipe was kneaded in a kneader to form a pressure-sensitive adhesive:

5      brominated butyl rubber    40 (parts by weight)  
 (Bromobutyl 2255, made by Japan Synthetic Rubber Co., Ltd.)  
 Polybutene 2000H    60  
 (made by Idemitsu Petrochemical Co. Ltd.)  
 10     Silica VN-3    12  
 (made by Nippon Silica Co. Ltd.)  
 trimethylol propane triacrylate    3  
 benzoin isopropyl ether    0.4  
 2,6-di-t-butyl-p-cresol    0.4

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## (B) Preparation of irregular section adhesive sheet

20     (1) The above pressure-sensitive adhesive was interposed between a polyester film of 100  $\mu\text{m}$  in thickness and a releasing polyester film and pressed at 80°C to provide a thickness of the adhesive layer of 0.4 mm.

(2) After the peeling of the releasing polyester film, a releasing film subjected to irregular section treatment (embossing) was put onto the pressure-sensitive adhesive layer so as to direct the treated surface to the adhesive layer and then pressed at 80°C to obtain an irregular section adhesive sheet.

25     The sectional profile of the thus obtained adhesive sheet is shown in Fig. 1a or 1b, wherein numeral 1 is a pressure-sensitive adhesive layer, numeral 2 a substrate of polyester film, and numeral 3 a releasing embossed polyester film.

(3) An ultraviolet ray was irradiated to each of the adhesive sheets obtained in the above items (1) (adhesion face was flat) and (2) (adhesion face was concave or convex) through a high pressure mercury lamp of 4 kW separated from the side of the releasing polyester film at a distance of 15 cm for 15 seconds, whereby the adhesive layer was crosslinked. Then, the releasing film was peeled from the sheet to prepare a sample to be tested.

After the above sample was laminated to a glass plate or a veneer plate, the peeling strength and shearing strength were measured to obtain results as shown in the following Table 1.

35

Table 1

40	Sectional shape	Glass plate		Veneer plate	
		peeling strength (kg/25 mm)	shearing strength (kg/cm <sup>2</sup> )	peeling strength (kg/25 mm)	shearing strength (kg/cm <sup>2</sup> )
45	flat	0.3	1.52	0.1	0.94
	concave	0.05	0.8	-	-
50	convex	0.01	0.36	0.01	0.34

As seen from Table 1, the peeling strength of the irregular section adhesive sheets according to the invention (sectional profile is concave or convex) is considerably lower than that of the flat section adhesive sheet, while the reduction of the shearing strength is small.

55     Therefore, the irregular section adhesive sheet according to the invention is easy in laminating and peeling, less in displacement during use and very high in reliability.

Example 2

Each of the same three adhesive sheets as in Example 1 was laminated to a glass plate and heated in an oven at 100°C for 500 hours, which was subjected to a peeling test. As a result, the irregular section adhesive sheets according to the invention were simply peeled from the glass plate, so that the lamination thereof could be repeated many times. On the contrary, the adhesive sheet having a flat surface was strongly bonded to the glass plate. If the latter sheet was forcedly peeled, the substrate of the polyester film was damaged and aggregation breakage was caused in the adhesive layer to make the reuse of the sheet impossible.

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Example 3

## (I) Preparation of adhesive sheet having parallel stripes of pressure-sensitive adhesive

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The same pressure-sensitive adhesive as prepared in the item A of Example 1 was applied onto a releasing paper by means of a roll coater provided with a comb-type doctor blade under heating (about 110°C), whereby the adhesive layer was formed in parallel stripes. Then, the adhesive layer was crosslinked by irradiating an ultraviolet ray through a high pressure mercury lamp of 4 kW for 10 seconds and transferred to a back surface of a wall paper made of a vinyl chloride resin to prepare a decorative wall paper having parallel striped adhesive layer.

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Fig. 2 shows the above decorative wall paper, wherein numeral 1 is a stripe of the pressure-sensitive adhesive layer, numeral 4 an air passage formed between the stripes, numeral 5 a releasing paper, and numeral 6 a substrate such as wall paper or the like.

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## (II) Preparation of adhesive sheet having islands of pressure-sensitive adhesive

A commercially available emulsion-type acrylic adhesive (made by Soken Kagaku Co. Ltd., solid content: 50%) was applied to a back surface of a wall paper in form of islands through a silk screening process as shown in Fig. 3.

As seen from Fig. 2, the pressure-sensitive adhesive 1 was placed in island form onto the substrate 6 (e.g. wall paper member) so as to provide air passages 4 and covered with the releasing paper 5.

Each of the decorative wall papers obtained in the items (I) and (II) with a size of 900×900 mm was subjected to a lamination test for concrete wall, veneer wall, steel wall, plaster wall or glass plate. As a result, the wall paper could easily be laminated without producing wrinkles, air pockets and the like.

**Claims**

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1. An irregular section adhesive sheet, characterized by comprising a substrate (2) and a pressure-sensitive adhesive layer (1) adhered to said substrate and having an uneven adhesion face.

2. An irregular section adhesive sheet as claimed in claim 1, characterized in that said pressure-sensitive adhesive has a crosslinking structure.

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3. An irregular section adhesive sheet as claimed in claim 1, characterized in that said pressure-sensitive adhesive is a rubber series adhesive.

4. An irregular section adhesive sheet as claimed in claim 3, characterized in that said rubber series adhesive is a butyl rubber series adhesive composed mainly of halogenated butyl rubber and/or ethylene-propylene-diene terpolymer rubber, polybutene, photopolymerizable compound, silica and photosensitizer and crosslinked through irradiation of ultraviolet rays.

5. An irregular section adhesive sheet as claimed in claim 1, characterized in that said pressure-sensitive adhesive is an acrylic series adhesive.

6. An irregular section adhesive sheet as claimed in any of claims 1-5, characterized in that said adhesion face of said pressure-sensitive adhesive layer is provided with air passages (4).

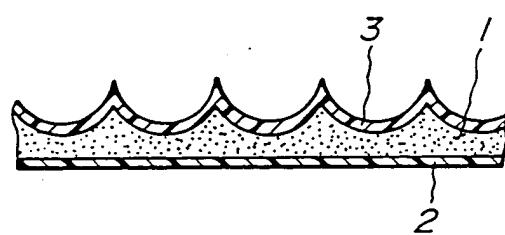
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7. An irregular section adhesive sheet as claimed in claim 6, characterized in that said air passages are formed by arranging said pressure-sensitive adhesive in the form of islands.

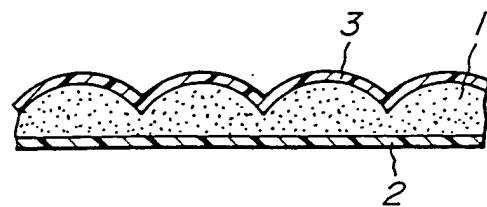
8. An irregular section adhesive sheet as claimed in claim 6, characterized in that said air passages are formed by arranging said pressure-sensitive adhesive in the form of stripes.

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*FIG. 1a*

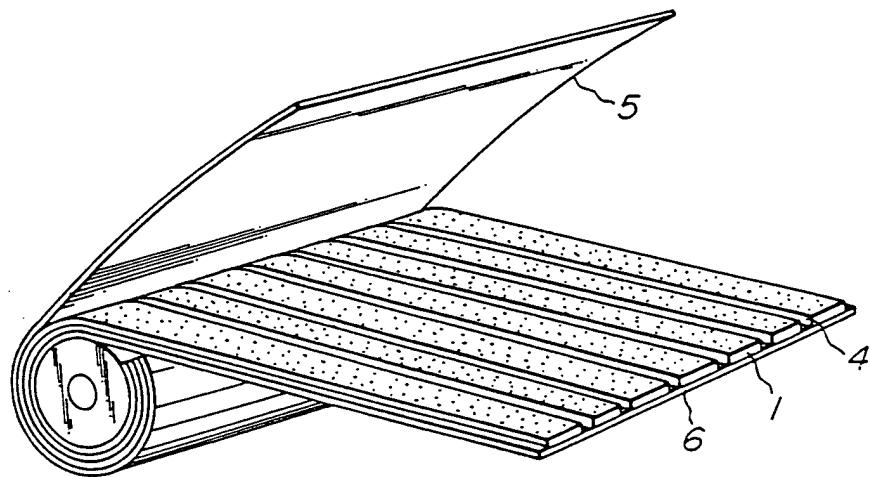


*FIG. 1b*

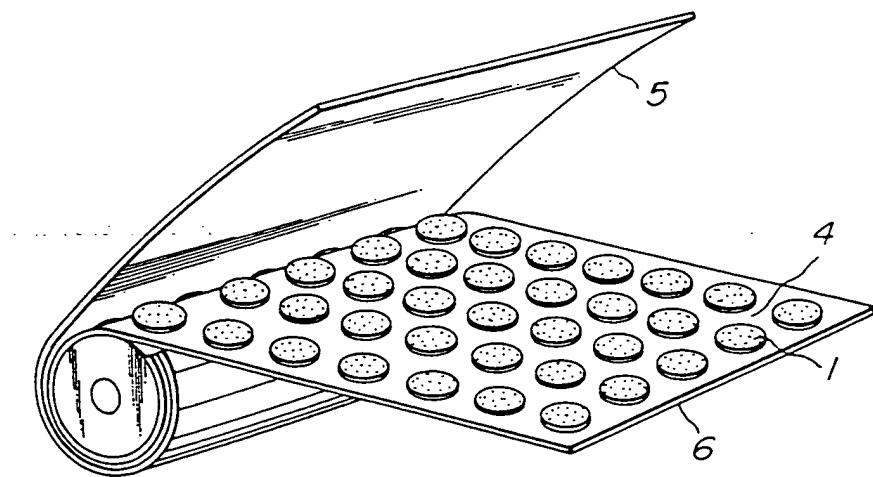


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**FIG. 2**



**FIG. 3**



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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A-3 417 746 (JACKSTÄDT) * Claims; figure 2 * ---	1	C 09 J 7/02
X	DE-A-3 537 433 (NICHIBAN CO.) * Abstract; page 9, lines 1-7; figures 1,2 * ---	1,3,5	
X	WO-A-8 504 602 (AVERY INTERN. CO.) * Claims 1,6,7; figures 1,2 * ---	1,2,5-7	
X	EP-A-0 149 135 (BEIERSDORF) * Claims; figures 1,2 * ---	1,2,5-7	
A	US-A-3 203 823 (W.S. GRIMES) -----	1,6	
TECHNICAL FIELDS SEARCHED (Int. Cl.4)			
C 09 J 7/02			
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search		Examiner
THE HAGUE	18-05-1988		GIRARD Y.A.
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